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Office Memorandum • UNITED STATES GOVERNMENT

TO : The Files

DATE: 15 October 1958

FROM: [redacted]

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SUBJECT: (Trip Report - [redacted])

1. On 30 September 1958 the writer visited the [redacted]. The purpose of the trip was to monitor progress on the [redacted] receiver, and to study the nature and results of [redacted] research on parametric amplifiers (mavars) and masers. Personnel participating in the discussions were:

[redacted]

2. Many of the specification changes being made by [redacted] on the standard [redacted] receiver being fabricated for this Agency. These modifications, some of which are highly desirable, can all be considered as bonuses, since their incorporation in the [redacted] receiver will not affect the amount of the fixed-price purchase order.

3. Continuously Variable Scan Rate: The specifications for the [redacted] receiver stipulate that scanning rates of 0.5, 1, 3, and 10 cycles per second be obtainable. The standard [redacted] however, now utilizes a servo-mechanism system to effect a continuously variable scan rate. This same servo system will be used on the [redacted] to vary the scan over the entire 0.5 to 10 cps range. The control knob will be calibrated to indicate the scanning rate with 5% accuracy. A lock will be provided on the control knob to prevent accidental changes in the setting.

4. Fixed Frequency Receiver Marker: Another feature on the standard [redacted] is a "birdie" marker, which may be incorporated (if desired) on the [redacted] receiver. This "birdie" marker would serve to indicate on the display tube the frequency of any fixed-tune receivers operated in conjunction with the sweep receiver. Local oscillator signals from any fixed-tuned receivers are mixed with the local oscillator frequency of the sweep receiver. As the sweep frequency crosses a fixed frequency, the zero-beat between the local oscillators produces a pulse which marks a bright spot on the trace of the display tube.

5. Trace End Brightener: [redacted] will include in the [redacted] receiver a method by which either end, or both ends, of the CRT trace can be brightened

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for an arbitrary length of time. The brightening of either end is effected by injecting a negative 30-volt pulse into the respective trace brightener input. Using this feature, it would be possible to superimpose coded time signals upon the ends of the trace. These time signals would be especially valuable in analyzing the filmed record of the receiver intercepts.

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6. Interference Gate: One of the most desirable changes effected on the [] specification is the inclusion of an interference gate in the receiver. This gate will be used to blank out undesired local signals of high intensity. Upon interception of signals stronger than an arbitrary level in the IF of the receiver, a 50 db attenuation is inserted into the circuit for a pre-set period of 100 to 3300 usec. The response of the circuitry is such that a time delay of only 0.5 to 100 microseconds occurs between the instant the gate is triggered and the attenuation of the signal by 50 db.

7. Reference Frequency Marking: Frequency marking lines will be superimposed upon the display tube at regular intervals, or at the will of the operator. When triggered by a 1-volt pulse, the marking circuits will intensity modulate the CRT beam with markings at either 10 mc or 50 mc intervals, depending upon which circuit has been triggered. On the [] this marking continues for a period of approximately 0.15 to 0.45 second. However, the [] with its optional low sweep speed of 0.5 cycles per seconds, will require a marking time of at least 1 second to assure that the markings will appear on one complete trace line of the display tube.

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8. Display Tubes: It has not yet been determined whether one or two display tubes will be used on the [] receiver. The original intent of the contractor was to utilize a single tube with dual-phosphors to serve both as the FTI (frequency-time-indication) display and the FI (frequency-intensity) display. However, if tests indicate that the quality of one or the other of the displays is compromised by combining them in one tube, the [] will incorporate a separate tube for each of the two displays.

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9. Converters: [] has been fabricating for this Agency a pair of DC-to-DC converters to be used as power supplies for travelling-wave-tube amplifiers. These converters were delivered to the [] on 9 September and are now undergoing test and evaluation.

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10. Maser Research: [] is constructing a 3-level solid-state cavity-type maser using a synthetic ruby as the paramagnetic salt. This maser is designed to operate at S-band frequencies. They are experimenting with a crystal alignment which will allow them to change signal frequency without varying the pump frequency. Further details and results of their research should be available soon.

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11. Parametric Amplifier Research: Parametric amplifiers, or mavars, have several clear-cut advantages over maser amplifiers. The noise figures obtainable are in the order of 1 to 3 db, the cost is potentially low, and the reliability should be high. Unlike masers, furthermore, no external magnetic fields or refrigeration are

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required. [] currently has Government contracts with the Air Force and the Signal Corps for R+D on parametric amplifiers. Although they have done some research using the difference-frequency mode of operation, they feel that most of their contributions to the field have been through their experiments using the sum-frequency mode. In this mode, the power output frequency (f_o) is the sum of the signal frequency (f_s) and the pump frequency (f_p). The output is reconverted to the signal frequency by heterodyning it with the pump frequency. This mode of operation does not produce the high gains which are available using the difference-frequency mode ($f_o = f_p - f_s$), but it exhibits greater stability and permits wider bandwidths and lower noise figures. [] has achieved noise figures of less than 2 db, and bandwidths of 20 to 30 megacycles with a signal frequency of 400 megacycles using the sum-frequency mode, and the company feels that [] are definitely within reach. Gain is approximately equal to $(1 + f_p/f_s)$, and a nominal 10 db gain requires that the pump frequency be nearly 10 times greater than the signal frequency. This type of parametric amplifier does not lend itself readily to high frequency operation, nor is it easily tunable. Its most obvious application is as a low noise, fixed-frequency, wide-band amplifier for L-band and S-band frequencies.

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